CLAIMS

What Is Claimed Is:

1. A method for emulating a surface electrocardiogram (EKG) of a patient in which an implantable cardiac stimulation device is implanted, the method comprising:

sensing separate cardiac signals using electrodes implanted within the patient; and

selectively concatenating portions of the separate cardiac signals to yield an emulated surface EKG.

2. The method of claim 1 wherein sensing cardiac signals comprises:

sensing atrial signals using at least one atrial electrode; and

sensing ventricular signals using at least one ventricular electrode.

3. The method of claim 2 wherein selectively concatenating portions of the cardiac signals comprises:

identifying far-field ventricular signals within the atrial channel signals;

identifying far-field atrial signals within the ventricular channel signals; and

concatenating the far-field atrial signals and the far-field ventricular signals to yield the emulated surface EKG.

4. The method of claim 2 wherein selectively concatenating portions of the cardiac signals further comprises:

determining a value representative of the peak magnitude of the far-field atrial signals;

determining a value representative of the peak magnitude of the far-field ventricular signals; and

adjusting the relative magnitudes of the far-field atrial signals and the far-field ventricular signals so as to achieve a predetermined ratio of peak atrial to peak ventricular magnitudes.

5. The method of claim 4 wherein the predetermined ratio of peak atrial to peak ventricular magnitude is in the range of 1:4 to 1:10.

6. The method of claim 2 wherein selectively concatenating portions of the cardiac signals comprises:

identifying near-field atrial signals within the atrial channel signals;

identifying near-field ventricular signals within the ventricular channel signals; and

concatenating the near-field atrial signals and the near-field ventricular signals to yield the emulated surface EKG.

7. The method of claim 2 wherein selectively concatenating portions of the cardiac signals further comprises:

determining a value representative of the peak magnitude of the near-field atrial signals;

determining a value representative of the peak magnitude of the near-field ventricular signals; and

adjusting the relative magnitudes of the near-field atrial signals and the near -field ventricular signals so as to achieve a predetermined ratio of peak atrial to peak ventricular magnitude.

8. The method of claim 7 wherein the predetermined ratio of peak atrial to peak ventricular magnitude is in the range of 1:4 to 1:10.

9. The method of claim 1 wherein sensing cardiac signals using electrodes implanted within the patient comprises:

sensing atrial signals using unipolar sensing by employing an atrial electrode in combination with a housing of the device; and

sensing ventricular signals using unipolar sensing by employing a ventricular electrode in combination with a housing of the device.

10. The method of claim 9 wherein the atrial electrode is a right atrial tip electrode, a right atrial ring electrode, an SVC coil electrode, a left atrial ring electrode, a left atrial coil electrode or a transseptal atrial electrode and wherein the ventricular electrode is a right ventricular tip electrode, a right ventricular ring electrode or a right ventricular coil electrode, a left ventricular tip electrode, a left ventricular ring or a ventricular epicardial electrode.

11. The method of claim 1 wherein selectively concatenating portions of the cardiac signals further comprises:

smoothing the emulated surface EKG at concatenation points.

12. The method of claim 1 wherein selectively concatenating portions of the cardiac signals further comprises:

aligning signal polarities of the concatenated portions.

13. The method of claim 1 further comprising controlling device functions based, in part, on the emulated surface EKG.

14. The method of claim 1 performed entirely by the implantable medical device.

15. The method of claim 1 performed by the implantable medical device in combination with a device external to the patient, and further comprising transmitting the separate cardiac signals to the external device and wherein selectively concatenating portions of the

cardiac signals to yield an emulated surface EKG is performed by the external device.

16. A system for emulating a surface electrocardiogram (EKG) of a patient, the system comprising:

sensing circuitry operative to sense separate cardiac signals using electrodes implanted within the patient; and

an EKG emulation unit operative to selectively concatenate portions of the separate cardiac signals sensed to yield an emulated surface EKG.

17. A method for emulating a surface electrocardiogram (EKG) of a patient in which an implantable cardiac stimulation device is implanted, the method comprising:

sensing far-field atrial cardiac signals using a ventricular electrode;

sensing far-field ventricular cardiac signals using an atrial electrode; and

combining the far-field atrial signals and the far-field ventricular signals to yield an emulated surface EKG.

18. The method of claim 17

wherein sensing far-field atrial cardiac signals using a ventricular electrode is performed by sensing both near-field ventricular signals and far-field atrial signals and then extracting only the far-field atrial signals; and

wherein sensing far-field ventricular cardiac signals using an atrial electrode is performed by sensing both near-field atrial signals and far-field ventricular signals extracting only the far-field ventricular signals.

19. The method of claim 17 wherein combining the far-field atrial signals and the far-field ventricular signals to yield an emulated surface EKG comprises:

concatenating the far-field ventricular signals sensed in the atria with the far-field atrial signals sensed in the ventricles.

20. The method of claim 17 wherein the signals sensed in the ventricles and the signals sensed in the atria are initially high pass filtered and further comprising applying an equalizer to the signals having a transfer function that is substantially the reciprocal of the high pass filter so as to restore low frequency components removed by the filter.

21. The method of claim 17 and further comprising:

smoothing the combined signals.

22. A system for emulating a surface electrocardiogram (EKG) of a patient, the system comprising:

first sensing circuitry operative to sense far-field atrial cardiac signals using a ventricular electrode;

second sensing circuitry operative to sense far-field ventricular cardiac signals using an atrial electrode; and

an EKG emulation unit operative to combine the far-field atrial signals and the far-field ventricular signals to yield an emulated surface EKG.

23. A system for emulating a surface electrocardiogram (EKG) of a patient, the system comprising:

means for sensing far-field atrial cardiac signals;

means for sensing far-field ventricular cardiac signals; and

means for combining the far-field atrial signals and the far-field ventricular signals to yield a combined signal.

24. A method for emulating a surface electrocardiogram (EKG) of a patient in which an implantable cardiac stimulation device is implanted, the method comprising:

sensing near-field atrial cardiac signals using an atrial electrode;

sensing near-field ventricular cardiac signals using a ventricular electrode;

concatenating the near-field ventricular signals with the near-field atrial signals to yield a concatenated signal.

25. The method of claim 24 and further comprising:

smoothing the concatenated signal at the concatenation points.